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Four new species of pseudoscorpions (Arachnida, Pseudoscorpiones: Neobisiidae, Chernetidae) from caves in Yunnan Province, China

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Four new species of pseudoscorpions (Arachnida, Pseudoscorpiones: Neobisiidae, Chernetidae) from caves in Yunnan Province, China. - The new species *Parobisium martii* sp. n., *Parobisium scaurum* sp. n., *Parobisium titanium* sp. n., and *Nudochernes lipsae* sp. n. are described from caves near the city of Zhen Xiong (Yunnan), and their taxonomic positions are discussed. *Parobisium titanium* sp. n., with a body length of about 4.5 mm, is the pseudoscorpion species with by far the largest known pedipalpal length of about 17 mm.

Key-words: China - Yunnan - biospeleology - Pseudoscorpiones - new species.

INTRODUCTION

The state of knowledge of the pseudoscorpion fauna of China has been reviewed by Schawaller (1995b) who cited 47 species, but this number certainly presents only a fraction of the diversity which might be expected in this country. Three species are recorded from Chinese caves: *Stenohya chinacavernicola* Schawaller, 1995 (Neobisiidae) (Sichuan Prov., two caves); *Megachernes* cf. *himalayensis* (Ellingsen, 1914) (Chernetidae) (Guangxi Prov., one cave) and *Megachernes* cf. *vietnamensis* Beier, 1967 (Hubei and Sichuan Prov., 3 caves). Harvey (1999) redescribed the type specimens of *Microcreagris lampra* Chamberlin, 1930, *M. orientalis* Chamberlin, 1930, and *M. silvestrii* Chamberlin, 1930 and transferred them to the genus *Biseto-creagris*. He emended the type locality of *B. orientalis* to Vietnam, and synonymized *Microcreagris chinensis* Beier, 1943 (= *Chinacreagris chinensis*) with *B. silvestrii*. Five speleological surveys of China have been carried out since 1992 by the French Federation of Speleology (Aventures Karstiques Lointaines), and the pseudoscorpions collected were sent to me by Mrs Josiane Lips (Lyon) (collections of 1992-1999) and Dr Philippe Marti (Geneva) (collection of 2001). The descriptions of the caves have been published by Degouve *et al.* (1999) who indicate also the French names and the GPS data.

The results of the first survey (1992) were published by Schawaller (1995b). Due to the fragmentary knowledge of the cave fauna of China it is not surprising that

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the four specimens collected represent four new species. At least two of them are highly specialized troglobionts and one of them is the pseudoscorpion species with by far the largest recorded pedipalpal length of about 17 mm. Types of the new species are deposited in the Muséum d'histoire naturelle, Geneva.

DESCRIPTIONS

Parobisium martii sp. n. Figs 1-4

Material: Holotype ♀, China, Yunnan Province, Zhen Xiong, Guo Quan Dong cave (Grotte du Cirque) (N 104°44,678 / E 27°29,712 GPS), leg. Ph. Marti, 30.III.2001 (no. 20) (collected near the end of the first hall, around a huge block near the separation of the two galleries).

Diagnosis: The new species is characterized by the morphometry and length of palpal segments (e.g. femur 4.25 x longer than broad, length 1.58 mm), by the presence of 6 setae on posterior border of the carapace, by the number of setae on cheliceral hand (6) and of sternal setae (14-16).

Etymology: Named in honour of the collector Dr Philippe Marti.

Description: Pedipalps and carapace reddish brown, tergites and sternites yellowish. Carapace slightly longer than broad, smooth, with a very weak sub-basal transverse impression, four small distinct eyes; 24 setae in total, of which 4 are at anterior and 6 at posterior margin, 2 ocular microsetae on each side; tergites undivided, chaetotaxy: I-IX mostly with 11 marginal setae, X 9 (2 tactile setae), XI 9 (2 tactile setae). Manducatory process with 4/5 bristles; coxae of pedipalps smooth, with 9 bristles (including one tactile seta), coxae I 8, II 6, III 4/5, IV 10 bristles; genital operculum with 13 setae (Fig. 4); sternites undivided, chaetotaxy: 14 + 5 microsetae on each stigma (the three central marginal setae shorter)/10+5/14/15/16/14/15/11 (2 tactile setae)/6 (2 tactile setae). Pleural membrane granulate. Chelicera: 6 setae on hand, fixed finger with 21, movable finger with 13 small pointed and partly rounded teeth, flattened and broad transparent spinneret present, serrula exterior with approximately 42 lamellae, serrula interior with approx. 31 lamellae, flagellum composed of 8 anteriorly-dentate blades, the first one with slightly enlarged base, the two proximal ones shorter.

Pedipalp (Figs 1-3): Trochanter with small dorsal hump, femur indistinctly granulate medially, 4.25 times longer than broad, patella smooth, 2.7 times, club 1.7 times longer than broad, hand finely granulate mediodistally, with pedicel 1.9 times longer than broad and 1.1 times longer than finger, chela with pedicel 3.45 times longer than broad; fixed finger with 83, movable finger with 81 small, pointed teeth; fixed finger with a short venom duct, nodus ramosus at base of claw. Trichobothrial pattern see Fig. 3; *est* in distal half, closer to *et* than to *ist*, five trichobothria grouped at base of finger.

Leg I: Femur 3.6 times longer than deep and 1.5 times longer than patella, patella 2.8 times longer than deep, tibia 5.9 times, basitarsus 3.3 times, telotarsus 5.1 times longer than deep and 1.5 times longer than basitarsus. Leg IV: femur+patella 3.8 times longer than deep, suture between them vertical, tibia 6.7 times longer than deep, tactile seta near middle (TS=0.46), basitarsus 2.9 times longer than deep, with one basal tactile seta (TS=0.17), telotarsus 5.1 times longer than deep and 1.5 times longer

than basitarsus, tactile seta at middle (TS=0.50); arolia undivided, clearly shorter than the smooth and slender claws, subterminal seta forked and dentate.

Measurements (length/width in mm): Carapace 1.23/1.18. Pedipalp: Femur 1.58/0.37, patella 1.35/0.50, hand with pedicel 1.44/0.77, length of finger 1.34, length of chela with pedicel 2.64. Leg I: Femur 0.84/0.23, patella 0.58/0.20, tibia 0.81/0.14, basitarsus 0.38/0.12, telotarsus 0.56/0.11; leg IV: Femur+patella 1.50/0.40, tibia 1.38/0.21, basitarsus 0.49/0.17, telotarsus 0.73/0.14.

Discussion: *Parobisium martii* sp. n. shows affinities with *Parobisium magnum chejuense* Morikawa, 1970 (from Seong-gul Cave, South Korea) and *Parobisium longipalpus* Hong, 1996 (Mt Chiri, South Korea). It shares with these species the chaetotaxy of carapace (6 setae on posterior border) and tergites (10-12 setae) and the number of teeth of chelal fingers. It differs from the female of *P. m. chejuense* by the smaller size (palpal femur 1.58 mm vs 1.82 mm), by a slightly more slender palpal femur (4.25 times vs 3.9 times) and chela (3.4 times vs 2.9 times), less numerous sternal setae (14-16 vs. 20-22) and the smaller number of setae on the cheliceral hand (6 vs 7). *Parobisium longipalpus* is clearly smaller (palpal femur length 1.05-1.16 mm vs 1.58 mm) and has 7 setae on the cheliceral hand; the trichobthrium *st* on movable finger is placed clearly distally compared to *est,* whereas in *martii* sp.n. *st* is level with *est.*

Parobisium titanium sp. n. Figs 5-9

Material: Holotype ♂, China, Yunnan Province, Zhen Xiong, Guo Quan Dong cave (Grotte du Cirque) (N104°44,678/ E 27°29,712 GPS), leg. Ph. Marti, 8.IV.2001 (no. 94) (collected at the bottom of the cave, on sand-bank near the terminal siphon).

Diagnosis: The species is characterized by its pedipalpal morphology and size, chaetotaxy of tergites (mostly 6 setae), by the presence of 5 setae on cheliceral hand and by the high number (13) of flagellum setae.

Etymology: From the latin adjectif *titanius* = titanic, gigantic.

Description: Pedipalps and carapace dark reddish-brown, tergites and sternites yellowish. Carapace 1.1 times longer than broad, smooth, with a very weak subbasal transverse impression, eyes or eyespots absent; with 20 setae in total, 6 of which are at anterior and 6 at posterior margin; tergites undivided, chaetotaxy: I 8, II-X 6, XI 8 (2 tactile setae). Manducatory process with 5 bristles; coxae of pedipalps smooth, with numerous setae, coxae I 6, II 6, III 5, IV 10 bristles; anterior genital operculum with about 55 central setae, posterior genital operculum (sternit III) with a small median groove and tiny lateral rod-like sclerotizations (Fig. 9); sternites with uniseriate chaetotaxy: approx. 26 marginal setae + 12 central discal setae + 2 suprastigmatal microsetae/16 + 5/20/18/16/14/12/ 8(?). Pleural membrane granulate. Chelicera (Fig. 5): 5 setae on hand, fixed finger with 11, movable finger with 10 pointed teeth, a small flattened transparent spinneret present, serrula exterior with about 44 lamellae, flagellum composed of 13 anteriorly-dentate blades, the anterior one with slightly enlarged base, the five proximal ones shorter.

Pedipalp (Figs 6-8): Trochanter without hump, femur smooth, 8.9 times longer than broad, patella 8.0 times, hand with pedicel 4.6 times longer than broad and 1.3 times longer than finger, chela with pedicel 7.8 times longer than broad; fixed finger with 103 small pointed teeth, movable finger with 110 pointed teeth (flattened in basal

half). Trichobothrial pattern see Fig. 8: five basal trichobothria, *est* in middle of finger, halfway between *ist* and *et; st* halfway between *sb* and *t*.

Leg I: Femur 7.3 times longer than deep and 1.5 times longer than patella, patella 5.5 times longer than deep, tibia 10.7 times, basitarsus 6.6 times, telotarsus 7.1 times longer than deep and 1.1 longer than basitarsus. Leg IV: Femur+patella 11.7 times longer than deep, suture vertical, tibia 15.6 times longer than deep, with a longer seta proximal of middle, basitarsus 6.8 times longer than deep, with a basal tactile seta, telotarsus 7.3 times longer than deep and 1.1 longer than basitarsus, a tactile seta distal of the middle; arolia undivided, clearly shorter than the smooth and slender claws; subterminal seta forked and dentate.

Measurements (in mm): Carapace 1.62/1.52. Pedipalps: Femur 4.43/0.50, patella 4.58/0.57, hand with pedicel 3.60/0.78, length of finger 2.80, length of chela with pedicel 6.08. Leg I: Femur 2.32/0.32, patella 1.55/0.28, tibia 2.25/0.21, basitarsus 1.12/0.17, telotarsus 1.20/0.17; leg IV: Femur+patella 4.08/0.35, tibia 3.90/0.25, basitarsus 1.30/0.19, telotarsus 1.38/0.19.

Discussion: The relationships of this new species are uncertain: no other *Parobisium* species shows a similar pedipalpal morphology. The flagellum has a morphology comparable to that of other species of this genus, but its number is much higher and perhaps size-dependent (13 serrate setae; versus 9 in *scaurum* sp. n., 8 in *martii* sp. n and *longipalpus* Hong). The extreme adaptation of the species to the hypogean environment and, mainly, the meagre knowledge of the cave fauna of this region makes it impossible to determine its relationships. Affinities might exist with *Parobisium scaurum* sp. n., but both species are insufficiently known. *Parobisium titanium* sp. n. stands out from all described pseudoscorpion species by possessing by far the longest pedipalps: 17 mm in length, with a body length of about 4.5 mm.

From the "Grotte du Cirque Guo Quan Dong" two new species of *Parobisium* are described. Whilst *P. martii* sp. n. is probably an epigean troglophilous species without evident morphological adaptations to the subterranean habitat, *P. titanium* sp. n. is a highly adapted troglobiont without any apparent affinities to *P. martii*.

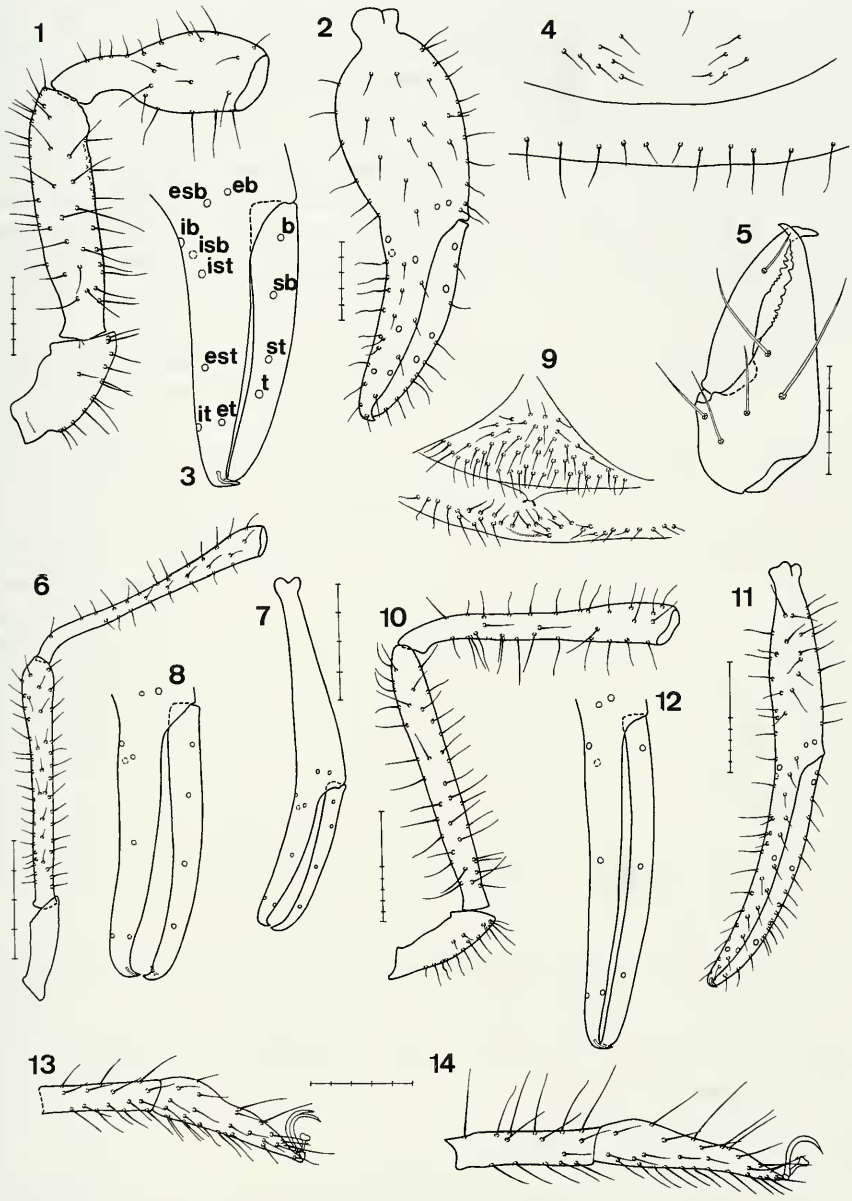
Parobisium scaurum sp. n. Figs 10-14

Material: Holotype tritonymph, China, Yunnan Province, Zhen Xiong, Da Hei Dhong cave (Grande Grotte Noire) (N 104°48,702/ E 27°22,804 GPS), leg. Josiane Lips, 20.VIII.1999 (no. 547).

Diagnosis: The morphometric data and the shape of its pedipalps are characterizing this species (e.g. femur 7.5 times longer than broad, length 2.48 mm); adults are unknown.

Etymology: The specific name refers to the inflated telotarsi of the walking legs (lat. *scaurus* = club-footed).

Description: Pedipalps brown, carapace, tergites and sternites yellowish. Carapace 1.1 times longer than broad, smooth, eyes or eye-spots absent; 20 setae in total, 4 of them are at anterior and 6 at posterior margin, one ocular microseta on each side present; tergites undivided, all with 6 setae, XI 6 (2 tactile setae). Manducatory process with 4 marginal bristles; coxae of pedipalps smooth, with 6/7 bristles, coxae I 8-9, II 7, III 4, IV 8 bristles; sternites undivided, chaetotaxy: 12 + 5 microchaetae on each



FIGS 1-14

1-4: *Parobisium martii* sp. n.; 1-2, pedipalp; 3, trichobothrial pattern on chelal fingers; 4, chaetotaxy of genital operculum and sternite III; scale units 0.1 mm. 5-9: *Parobisium titanium* sp. n.; 5, chelicera; 6-7, pedipalp; 8, trichobothrial pattern on chelal fingers; 9, chaetotaxy of genital operculum and sternite III; scale units 0.1 mm (Fig. 5), 0.5 mm (Figs 6, 7). 10-14: *Parobisium scaurum* sp. n.; 10-11, pedipalp; 12, trichobothrial pattern on chelal fingers; 13, basi- and telotarsus of leg I; 14, basi- and telotarsus of leg IV; scale units 0.1 mm.

stigma/12 + 6/21/18/17/15/12/10/4 (2 tactile setae). Pleural membrane granulate. Chelicera: 6 setae on palm, fixed finger with 15, movable finger with 13 small, pointed teeth, a small rounded transparent spinneret present, serrula exterior with 40 lamellae, flagellum composed of 9 serrate blades, first one slightly dilated at base, two posterior ones distinctly shorter.

Pedipalp (Figs 10-12): Trochanter without hump, femur smooth, 7.5 longer than broad, patella 7.0 times, club 4.7 times, hand with pedicel 3.8 times longer than broad, chela with pedicel 8.6 times longer than broad, finger 1.3 times longer than hand; fixed finger with 105 small pointed teeth, movable finger with 105 pointed teeth (flattened in basal half). Trichobothrial pattern see Fig. 12: apparently comparable to that of *P. titanium* sp. n.

Leg I: Femur 5.4 times longer than deep and 1.4 times longer than patella, patella 4.7 times longer than deep, tibia 8.1 times, basitarsus 4.1 times longer than deep, telotarsus distinctly inflated at base, 3.8 times longer than deep and 1.3 times longer than basitarsus (Fig. 13). Leg IV: Femur+patella 8.5 times longer than deep, suture vertical, tibia 11.1 times longer than deep, with two longer setae near middle and near distal end, basitarsus 4.6 times longer than deep, with a basal tactile seta, telotarsus 4.3 times longer than deep and 1.2 times longer than basitarsus, distinctly inflated at base, tactile seta absent, with a slightly longer seta near middle (Fig. 14); arolia undivided, clearly shorter than the smooth and slender claws, subterminal seta forked and dentate.

Measurements (length/width in mm): Carapace 1.21/1.11. Pedipalp: Femur 2.48/0.33, patella 2.50/0.36, hand with pedicel 1.77/0.46, length of finger 2.26, length of chela with pedicel 3.98. Leg I: Femur 1.26/0.22, patella 0.87/0.19, tibia 1.14/0.14, basitarsus 0.58/0.14, telotarsus 0.77/0.20; leg IV: Femur+patella 2.29/0.27, tibia 2.02/0.18, basitarsus 0.77/0.17, telotarsus 0.93/0.22.

Discussion: This species is unfortunately known only from a tritonymph, but there is no doubt that it represents a new species, being characterized by its morphometric data and the shape of pedipalps. Affinities might exist with *P. titanium* sp. n., but from this species *scaurum* sp.n. differs clearly by the shape of chelal hand and the length of chelal finger which is 1.3 times longer than hand in *scaurum*, but 1.3 shorter than hand in *titanium*. The unusual morphology of its telotarsi, with an enlarged base, might represent a diagnostic character of this species, but it also might be a nymphal character (?). Such inflated tarsi have been recorded from tritonymphs of syarinid species (e.g., *Pseudoblothrus strinatii* Vachon, *Hadoblothrus gigas* di Caporiacco) (Vachon, 1954; Mahnert, 1980).

Discussion of the genus *Parobisium*

First described as subgenus of *Neobisium* Chamberlin, the genus *Parobisium* is characterized within the family Neobisiidae by the absence of a galea on the movable cheliceral finger and by its trichobothrial pattern with a basal/subbasal cluster of five trichobothria and only three trichobothria in the distal half of fixed chelal finger (*est – et – it*) (Chamberlin, 1962). Only 16 species and subspecies are currently recognized in this genus which is known from North America (six taxa), Japan (seven taxa) and Korea (four taxa) (Harvey, 1991; Hong, 1996). Cave dwelling species or subspecies are recorded from Japan, South Korea and the USA (Harvey, 1991). Beier's (1937) sug-

gestion that *Neobisium rathkii* sensu Menge might belong to *Parobisium* is not corroborated by Judson (2003). The Asian species seem to differ from the North American ones in the position of trichobothrium *est*, which is placed near *et/it* forming a dense cluster of three trichobothria in American species, but is clearly separated from the distal pair *et/it* and situated near the finger middle in Asian species.

The systematic situation of neobisiid genera needs clarification, particularly in this Asian region, a first attempt was published by Curcic (1983). The trichobothrial pattern typical for *Parobisium* is also present in the genus *Bisetocreagris* Curcic, which possesses an identical flagellar morphology (all setae serrate) as well. However, the latter genus is characterized by the presence of tactile setae on tarsi of at least leg IV (lacking in at least some species of *Parobisium*?), by the presence of a bisetous median groove on sternite III of the male and of a galea, although the latter character seems to be of limited value at the generic level (Judson, 1992).

Nudochernes lipsae sp. n. Figs 15-21

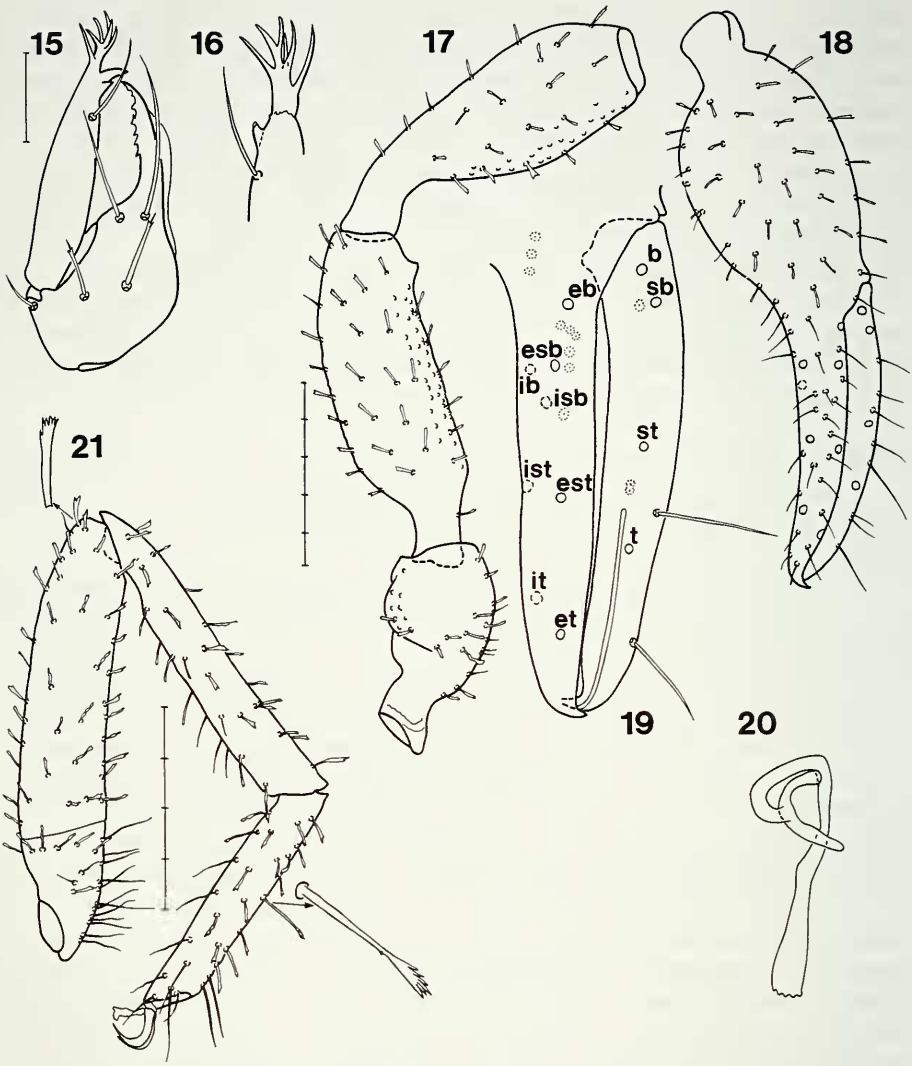
Material: Holotype ♀, China, Yunnan Province, Zhen Xiong, Da Hei Dong cave (Grande Grotte Noire) (N 104°48,702/ E 27°22,804 GPS), leg. Josiane Lips, 20.VIII.1999 (no. 547).

Diagnosis: The stout pedipalps and their length characterize the new species (pedipalpal femur 3.2 times longer than broad, length 0.91 mm); femur pedicillate, not broadened at its base.

Etymology: Named in honour of Mrs Josiane Lips (Lyon) for her sustained interest in pseudoscorpions.

Description: Pedipalps and carapace reddish brown, tergites and sternites yellowish. Carapace as long as broad, densely granulate, with two granulate transverse furrows, eyes or eyespots absent; 8 setae at anterior and 12 (+ 4 submarginal ones) at posterior margin; setae of carapace and tergites indistinctly clavate and apically dentate; tergites divided, chaetotaxy of half-tergites: 9 - 9 - 9+ 1 lateral seta –10+ 1 lateral + 1 medial seta – 9/1/1 – 8/1/1 – 8/1/1 – 6/1/1 – 5/1/1 – 6/0/1, XI totally 12 (4 longer setae), lateral, submedial and medial setae longer on hind tergites. Manducatory process with 3 marginal and 1 discal setae; coxae of pedipalps granulate, with 35 setae (1 tactile seta, distal ones slightly clavate), coxae I 23, II 27, III approx. 36 setae; IV numerous setae; genital operculum with 28 setae (in semi-circular arrangement), spermatheca (Fig. 20) with a long unpaired stem and two short apical tubules; sternites divided, setae finely dentate and long, chaetotaxy: 4+4 suprastigmal microchaetae - 4+4 - 10 - 8/1 med. seta/1 lat. seta - 7/1/1 - 8/1/1 - 5/1/1 - 4/1/1 – 5/0/1, XI totally 9 (4 setae longer). Chelicera (Fig. 15): 5 setae on palm, *db* and *ib* dentate, fixed finger with 5 proximad-directed teeth, movable finger with broad tooth-like subapical lobe, galea (Fig. 16) with 6 long branchlets in distal part, serrula exterior with 20 lamellae, flagellum with three apically dentate blades.

Pedipalp (Figs 17-19): Trochanter with distinct rounded dorsal hump, femur finely granulate, 3.2 longer than broad, patella finely granulate medio-distally, 3.0 times, club 2.1 times longer than broad, hand indistinctly granulate medio-distally, with pedicel 2.0 times longer than broad and 1.05 times longer than finger, chela with pedicel 3.7 times longer than broad; fixed finger granulate in basal half, with 47 pointed



FIGS 15-21

Nudochernes lipsae sp. n.; 15, chelicera; 16, galea, in detail; 17-18, pedipalp; 19, trichobothrial pattern on chelal fingers; 20, spermatheca; 21, leg IV; scale units 0.1 mm.

teeth, 6 external and 2 internal accessory teeth, movable finger with 54 pointed teeth, 5 external and 2 internal accessory teeth; nodus ramosus closer to *t* than to *st*. Trichobothrial pattern see Fig. 19: *est* halfway between *et* and *esb*, *ist* nearly at same level.

Leg I: Femur 1.7 times longer than deep, patella 3.5 times longer than deep and 1.6 times longer than femur, tibia 5.0 times, tarsus 5.7 times longer than deep. Leg IV (Fig. 21): Femur+patella 5.3 times, tibia 6.4 times, tarsus 5.8 times longer than deep,

with a slightly longer and dentate seta in the middle; arolia undivided, slightly shorter than the smooth and large claws, subterminal seta smooth and curved.

Measurements (in mm): Carapace 0.92/0.95. Pedipalp: Femur 0.91/0.28, patella 0.93/0.31, hand with pedicel 0.82/0.41, length of finger 0.78, length of chela with pedicel 1.53. Leg I: Femur 0.29/0.18, patella 0.47/0.13, tibia 0.48/0.10, tarsus 0.45/0.08; leg IV: Femur+patella 0.88/0.17, tibia 0.71/0.11, tarsus 0.55/0.09.

Discussion: The new species is placed in the genus *Nudochernes* Beier, known from the Afrotropical region (East and Central Africa), and with one species recorded from Israel, because of the following combination of characters: T-shaped spermatheca with short lateral arms; vestitural setae dentate (indistinctly clavate); presence of an elongate dentate seta on tergite XI; presence of an elongate dentate seta on tarsus IV.

Several species currently placed in *Allochernes* may also belong to *Nudochernes*, e.g. *Allochernes tropicus* (Beier) from Thailand (Beier, 1967) and China, Sichuan Province (Schawaller, 1995b) and *Allochernes liwa* Harvey, 1988 from Sumatra. Both have (pseudo-)tactile tarsal setae. *Nudochernes lipsae* sp. n. differs from *A. tropicus* in having stouter pedipalps (e.g., palpal femur 3.2 times vs 4.2 times) and much smaller size (e.g., length of palpal femur 0.91 mm vs 1.45 mm). *Allochernes himalayensis* Beier, 1974 from Nepal has a more slender palpal femur and chela, and is smaller than *lipsae* sp. n. (femur length 0.75 mm vs. 0.91 mm). The new species differs from species of this genus from Japan or Mongolia by the shape of palpal femur and by morphometric data. The wide-spread species *Allochernes asiaticus* (Redikorzev) (Schawaller, 1995a) has been transferred to *Wyochernes* Hoff which is characterized by the quite different shape of spermatheca and a different trichobothrial pattern. Affinities of *Allochernes asiaticus nepalensis* Morikawa, 1968 are doubtful, but it possesses a trichobothrial pattern similar to that of *Wyochernes* (Muchmore, 1996).

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